

REMARKS

The present Preliminary Amendment is submitted to delete the reference numerals in the claims and to remove multiple dependencies of claims 6-10, 28, 37-38 and 43-47, thereby placing such claims in condition for examination and reducing the required PTO filing fee.

Also, the specification and abstract have been reviewed and revised in order to make a number of minor editorial amendments and to remove the reference numerals from the abstract. Note that the changes to the abstract are submitted in the form of a substitute abstract.

Copies of the amended portions of the specification and claims with changes marked therein is attached and entitled "Version with Markings to Show Changes Made."

Respectfully submitted,

Hiroaki ONISHI et al.

By 

Michael S. Huppert
Registration No. 40,268
Attorney for Applicants

MSH/kjf
Washington, D.C. 20006-1021
Telephone (202) 721-8200
Facsimile (202) 721-8250
January 24, 2002

531 Rec'd PCT/FI 24 JAN 2002

(refer to, for example, Pf in Fig. 38B) needed for the filling only for a short time (refer to L in Fig. 38). On the other hand, the squeegees 12a and 12b provided with the pressurizing members 28 produce the required pressure
5 needed for the filling for a long time even if the squeegee speed is increased (refer to K in Fig. 38B).

① As described above, by virtue of the squeegees 12a and 12b provided with the pressurizing members 28, a sufficient amount of solder paste 7 can stably be filled
10 into the openings [5]⁴ of the printing mask 3 even if the squeegee speed is increased.

The narrow path 34 preferably has a gap of about 1 mm to 3 mm generated between the path and the printing mask 3 as described hereinabove, and it is only required to
15 generate a gap of about 0.5 mm to 10 mm between the path and the printing mask 3.

A control method for controlling the squeegee driving conditions including the pressurizing member 28 will be described next on the basis of the solder paste
20 filling pressure detected by the pressure sensor 51 arranged on the lower surface of the printing mask 3, which is the characteristic construction of the solder paste printing apparatus 210 of the fifth embodiment, with
reference to the control block diagram shown in Fig. 39.

25 The squeegee driving conditions are controlled by the

control unit 24 shown in Fig. 36 and Fig. 39.

② The solder paste filling pressure detected by the pressure sensor 51 is patterned as waveform data indicated by, for example, K in Fig. ^{38B}[38A] by a waveform generating section 61 of the control unit 24 and transmitted to an operating section 62. The operating section 62 refers to a database 64 that has preparatorily stored normal waveform data, or the information, which is the pressure waveform of the solder paste and becomes a criterion of decision, and determines whether or not the waveform of the measured filling pressure of the solder paste 7 is normal by comparison.

Then, if the waveform of the measured filling pressure of the solder paste 7 is normal as a result of this comparison, then the operating section 62 does not perform the following adjustment operation of the squeegee driving conditions. If the waveform of the measured filling pressure of the solder paste 7 is abnormal as a consequence of comparison and it is determined that the adjustment of the squeegee driving conditions is needed, then operation signals are appropriately outputted to a up-and-down driving driver 65 for vertically driving the squeegee, a printing driving driver 66 for squeegee printing driving, a horizontal movement driver 67 for the horizontal movement of the pressurizing member, and a

CLAIMS

1. (Amended) A solder paste printing apparatus for printing a
solder paste (7) supplied onto a surface (3a) of a printing
mask (3) where an opening (4) is formed by moving a
5 squeegee (12a, 12b) on the surface in a printing direction
on a circuit-forming body (5) placed on a back surface of
the printing mask via the opening, the device comprising:

an elongated pressurizing member (28, 28A, 28B,
28C, 28D) that has an axial direction extended roughly
10 parallel to an axial direction of the squeegee and is able
to form between the pressurizing member and the printing
mask a first gap (34) through which the solder paste can
pass in a direction opposite to the printing direction of
the squeegee during solder paste printing and is arranged
15 so as to form between the pressurizing member and the
squeegee a second gap (36) through which the solder paste
can pass from the first gap toward the squeegee side, the
pressurizing member being provided in a vicinity of an edge
of the squeegee, whereby a pressure toward the printing
20 mask is applied to the solder paste by the pressurizing
member when the solder paste passes through the first gap
located between the pressurizing member and the printing
mask during the solder paste printing.

2. (Amended) A solder paste printing apparatus as claimed in
25 claim 1, wherein the pressurizing member is movably mounted

with respect to the squeegee between a pressurizing position (~~P1~~) where the pressure is applied to the solder paste and a retreated position (~~P2~~) where the applying of the pressure is released, provided with an axial direction extended roughly parallel to the axial direction of the squeegee in the pressurizing position, is able to form the first gap (~~34~~) through which the solder paste can pass in the direction opposite to the printing direction of the squeegee during the solder paste printing, and is arranged so that the second gap (~~36~~) through which the solder paste can pass from the first gap toward the squeegee side is arranged between the pressurizing member and the squeegee.

3. (~~Amended~~) A solder paste printing apparatus as claimed in claim 1, wherein the pressurizing member (~~28~~) is a round bar.

4. (~~Amended~~) A solder paste printing apparatus as claimed in claim 1, wherein the pressurizing member (~~28~~) has a built-in heat-generating element (~~38~~) for heating the solder paste.

5. A solder paste printing apparatus as claimed in claim 1, wherein a pair of squeegees are provided, and at least one of the pair of squeegees is consistently brought in contact with the printing mask at least during printing.

6. (~~Amended~~) A solder paste printing apparatus as claimed in

[any one of] claims 1 [through] 5, wherein the first gap has a

roughly wedge-shaped cross-section shape that is narrowed toward the squeegee.

7. (Amended) A solder paste printing apparatus as claimed in [any one of] claims 1 [through] 5, wherein the pressurizing member has a height ~~(H2)~~ from the surface of the printing mask, the height ~~(H2)~~ being lower than a rolling height ~~(H1)~~ of the solder paste during printing, and the pressurizing member sinks in the rolling solder paste during the printing.

10 8. (Amended) A solder paste printing apparatus as claimed in [any one of] claims 1 [through] 5, wherein the pressurizing member is fixed so as to be unable to rotate.

15 9. (Amended) A solder paste printing apparatus as claimed in [any one of] claims 1 [through] 5, wherein a cross-section shape perpendicular to the axial direction of the pressurizing member ~~(28D)~~ is varied in the axial direction of the pressurizing member according to a number and a size of the openings of the printing mask, thus varying the pressure to be applied from the pressurizing member to the solder paste against the printing mask.

20 10. (Amended) A solder paste printing apparatus as claimed in [any one of] claims 1 [through] 5, wherein the pressurizing member is rotated in a direction reverse to a rolling direction of the solder paste around the pressurizing member during printing.

25

30031852 012403

11. A solder paste printing method for printing a solder paste located on a surface of a printing mask where an opening is formed by moving a squeegee on the surface in a printing direction on a circuit-forming body placed on a back surface of the printing mask via the opening, the method comprising:

applying a pressure toward the printing mask from the pressurizing member to the solder paste by making the solder paste pass in a direction opposite to the printing direction of the squeegee through a first gap formed between the printing mask and the pressurizing member during solder paste printing in a state in which an elongated pressurizing member ~~(28, 28A, 28B, 28C, 28D)~~ provided in a vicinity of an edge of the squeegee is positioned in a pressurizing position where a pressure is applied to the solder paste from a retreated position where no pressure is applied thereto; and making the solder paste pass again through the first gap located between the pressurizing member and the printing mask after the solder paste that is passing from the first gap toward the squeegee side passes through a second gap located between the squeegee and the pressurizing member.

12. A solder paste printing method as claimed in claim 11, wherein an interval of the first gap is smaller than a rolling height of the solder paste during printing,

and the pressurizing member sinks in the rolling solder paste during printing.

13. A solder paste printing method as claimed in claim 11, wherein the pressurizing member is fixed so as to be unable to rotate.

14. A solder paste printing method as claimed in claim 11, wherein a cross-section shape perpendicular to the axial direction of the pressurizing member ~~(20D)~~ is varied in the axial direction of the pressurizing member according to a number and a size of the openings of the printing mask, thus varying the pressure to be applied from the pressurizing member to the solder paste against the printing mask.

15. A solder paste printing method as claimed in claim 11, wherein the pressurizing member is rotated in a direction reverse to a rolling direction of the solder paste around the pressurizing member during printing.

16. ^(Amended) A solder paste printing apparatus as claimed in claim 1, further comprising:

a pressure sensor ~~(51)~~ that is provided within a range of printing on the back surface of the printing mask, which is a range in which the squeegee moves and detects a pressure of the solder paste applied via a pressure detection opening formed on the printing mask; and

a control means ~~(24)~~ for controlling driving

conditions of the squeegee in correspondence with a detection result of the pressure sensor.

17. (Amended) A solder paste printing apparatus as claimed in claim 16, wherein the control means ~~(24)~~ executes control on a basis of a pressure waveform that represents a change with a lapse of time of the pressure of the solder paste detected by the pressure sensor.

18. (Amended) A solder paste printing apparatus as claimed in claim 16, wherein the control means ~~(24)~~ is provided with a database ~~(64)~~ in which a pressure waveform of the solder paste is registered and controls the driving conditions of the squeegee by comparing the pressure waveform detected by the pressure sensor with the solder paste pressure waveform that is registered in the database and becomes a criterion of decision.

19. (Amended) A solder paste printing apparatus as claimed in claim 16, wherein a squeegee up-and-down drive device ~~(16,~~ ~~18)~~ for changing a relative position in the vertical direction of the squeegee with respect to the printing mask is provided, and the relative position is adjusted by driving the squeegee up-and-down drive device by the control means ~~(24)~~.

20. (Amended) A solder paste printing apparatus as claimed in claim 16, wherein a printing drive device ~~(26)~~ for moving the squeegee in the printing direction is provided, and a

travel speed in the printing direction of the squeegee is adjusted by driving the printing drive device by the control means ~~(24)~~.

21. ~~(Amended)~~ A solder paste printing apparatus as claimed in claim 16, wherein a pressurizing member horizontal movement mechanism ~~(231)~~ for changing a relative position of the pressurizing member with respect to the squeegee is provided, and the relative position of the pressurizing member is adjusted by driving the pressurizing member horizontal movement mechanism by the control means ~~(24)~~.

22. ~~(Amended)~~ A solder paste printing apparatus as claimed in claim 16, wherein a pressurizing member vertical movement mechanism ~~(232)~~ for changing a relative position of the pressurizing member with respect to the printing mask is provided, and the relative position of the pressurizing member is adjusted by driving the pressurizing member vertical movement mechanism by the control means ~~(24)~~.

23. A solder paste printing apparatus as claimed in claim 16, wherein the pressure sensor is provided short of a printing start end of the circuit-forming body, and the pressure detection of the solder paste is performed before starting the printing of the circuit-forming body.

24. A solder paste printing method as claimed in claim 11, wherein the pressure of the solder paste flowing between the pressurizing member and the printing mask is

increased by the pressurizing member provided in a vicinity of the edge portion of the squeegee, and the driving conditions of the squeegee are controlled by detecting the increased pressure of the solder paste and comparing the detected pressure with a specified pressure preparatorily registered.

25. A solder paste printing method as claimed in claim 24, wherein the pressure of the solder paste is measured before starting pattern printing of the circuit-forming body, and the control of the driving conditions of the squeegee is completed before starting the pattern printing.

26. (Amended) A screen printing method for printing a printing paste on a board ~~(311)~~ supported by a support base ~~(340)~~ via a screen ~~(312)~~ supported by a screen table section ~~(320)~~ by means of a printing head section ~~(370)~~, comprising:

positioning the board on the support base in a specified position by supporting and positioning the board on the support base with the support base with the board loaded moved up and down with respect to a movable frame ~~(346)~~ capable of moved up and down with respect to the table section, moving up the movable frame with respect to the table section roughly in synchronization with these operations, and horizontally moving the table section in a

direction roughly perpendicular to a board loading and unloading direction;

making the recognition camera (308) recognize a reference position mark preparatorily given to the board in accordance with a horizontal movement of the recognition camera in the board loading and unloading direction and a horizontal movement of the table section in a direction roughly perpendicular to the board loading and unloading direction; and

10 performing relative positional alignment of the board with the screen by horizontally moving the table section in a direction roughly perpendicular to the board loading and unloading direction on a basis of a position of the reference position mark recognized by the recognition camera, moving the screen table section that supports the screen in the board loading and unloading direction, and rotating the screen table section within a horizontal plane roughly parallel to the board on the support base.

27. A screen printing method as claimed in claim 26, wherein the board on which the printing paste is not printed is loaded in the board loading and unloading direction onto the support base supported vertically movably by the movable frame vertically movable with respect to the table section, and the board on which the printing paste has already been printed is unloaded in the

board loading and unloading direction roughly in synchronization with the board loading operation.

28. (Amended) A screen printing method as claimed in claim '26

[or 27], wherein the recognition camera further recognizes

5 the reference position mark preparatorily given to the screen in accordance with the horizontal movement of the recognition camera in the board loading and unloading direction and in the direction roughly perpendicular to the board loading and unloading direction.

10 29. (Amended) A screen printing apparatus for printing a printing paste on a board (311) supported by a support base (340) via a screen (312) supported by a screen table section (320) by means of a printing head section (370), comprising:

15 the screen table section (320) that is horizontally movably supported by a device frame (313);

a table section horizontal movement device (322) for horizontally moving the table section in the direction roughly perpendicular to the board loading and unloading direction;

20 a movable frame (346) that is vertically movably supported by the table section;

the support base (340) vertically movably supported by the movable frame;

25 a screen table section that is arranged above the

10031652 012402

support base and supports the screen;

5 a printing head section that is arranged above the screen table section and prints the printing paste on the board via the screen supported by the screen table section;

a board loading device that loads the board, on which the printing paste is not printed, onto the support base in the board loading and unloading direction;

10 a board unloading device that unloads the board, on which the printing paste has already been printed, on the support base in the board loading and unloading direction;

15 a movable frame elevation device that is provided in the table section and moves up and down the movable frame with respect to the table section;

a support base elevation device that is provided on the movable frame and moves up and down the support base with respect to the movable frame;

20 a board regulation device that positions the board on the support base;

a screen table section horizontal movement device that horizontally moves the screen table section in the board loading and unloading direction;

25 a screen table section rotation device that rotates the screen table section in the horizontal plane

100318550 012402

roughly parallel to the board supported on the support base;

5 a recognition camera that is provided horizontally movably in the board loading and unloading direction and in the direction roughly perpendicular to the board loading and unloading direction and is able to recognize the reference position marks preparatorily given to the board and the screen; and

10 a control means for controlling said devices and the recognition camera,

15 the control means executing roughly in synchronism the loading of the board onto the support base by the board loading device and the unloading of the board from the support base by the board unloading device in the board loading and unloading direction,

20 the control means executing roughly in synchronism the support of the board on the support base in accordance with the elevating operation of the support base by the support base elevation device, positioning of the board on the support base by the board regulation device, upward movement of the movable frame by the movable frame elevation device, horizontal movement of the table section in the direction roughly perpendicular to the board loading and unloading direction by the table section horizontal movement device, and positioning of the board to a

25

10031855-01E402

specified position where the reference position mark recognition is performed by the recognition camera in accordance with the upward movement of the movable frame and the horizontal movement of the table section, and

5 the control means executing the relative positional alignment of the board with the screen by controlling roughly in synchronism the table section horizontal movement device, the screen table section horizontal movement device, and the screen table section rotation device on a basis of the positions of the respective reference position marks of the board and the screen recognized by the recognition camera.

10 30. (Amended) A screen printing apparatus as claimed in claim 29, wherein the support base is vertically movably supported on a guide shaft ~~(327)~~ fixed to the movable frame,

15 the support base elevation device has on the movable frame a ball thread mechanism constructed of a ball thread shaft ~~(343)~~ that has an outer peripheral surface on which a ball thread is formed and a ball thread nut ~~(344)~~ that is provided on the support base and meshed with the ball thread shaft and a support base elevation motor ~~(345)~~ that rotates the ball thread shaft of the ball thread mechanism, and

20 the movable frame elevation device further has in 25 the table section a ball thread mechanism constructed of a

10031652 012402

ball thread shaft ~~(343)~~ commonly used for the support base elevation device and a ball thread nut ~~(348)~~ that is meshed with the ball thread shaft and rotatably supported by the table section and a movable frame elevation motor ~~(349)~~ that rotates the ball thread nut of the ball thread mechanism.

31. *(Amended)* A screen printing apparatus as claimed in claim 29 *[or 30]* comprising:

a board stopper ~~(352)~~ that is provided on the support base while being able to advance and retreat and stops the board in a specified position on the support base by being engaged with a fore end portion of the board loaded onto the support base by the board loading device; and

a board detection sensor ~~(353)~~ that is provided for the board stopper and detects presence or absence of a board on the support base,

the control means controlling the board loading device and the board unloading device on a basis of a board detection signal from the board detection sensor.

32. A screen printing apparatus as claimed in claim 31, wherein a cushioning member ~~(354)~~ is provided on an engagement surface that belongs to the board stopper and is engaged with the board.

33. *(Amended)* A printing screen cleaning method for cleaning a

printing screen by sliding a wiping member ~~(505)~~ on a lower surface of the printing screen ~~(504)~~ for supplying a printing paste ~~(503)~~ onto a circuit-forming body ~~(502)~~ through a printing paste supply section ~~(501)~~ of a specified pattern with the wiping member ~~(505)~~ backed up by a backup member ~~(506)~~ so as to wipe the printing paste stuck to the lower surface and sucking the paste via the wiping member through a suction port ~~(508)~~ provided through the backup member, whereby the printing paste that is stuck to the lower surface of the printing screen or staying in the printing paste supply section is stuck by suction to the wiping member side and kept by the wiping member,

the cleaning being performed by sliding the wiping member on the printing screen in a state in which the backup of the wiping member is partially released by a groove ~~(509)~~ located in the sliding direction with respect to the suction port of the backup member.

34. *(Amended)* A printing screen cleaning device for supplying a printing paste ~~(503)~~ onto a circuit-forming body ~~(502)~~ through a printing paste supply section ~~(501)~~ of a specified pattern, comprising:

a cleaning head ~~(521)~~ that sucks the paste via a wiping member ~~(505)~~ while sliding the wiping member on a lower surface of a printing screen ~~(504)~~ with the wiping member backed up by a backup member ~~(506)~~ through a suction

100318550-012400

port ~~(508)~~ provided on a backup surface ~~(506a)~~ for performing the backup,

the backup member having on the backup surface a groove ~~(509)~~ that partially releases the backup of the wiping member in the sliding direction with respect to the suction port.

35. ~~(Amended)~~ A printing screen cleaning device as claimed in claim 34, wherein the suction port is provided in a suction region ~~(507)~~ extended in a direction roughly perpendicular to the sliding direction on the backup surface of the backup member, and a groove ~~(509)~~ that is parallel to the suction region and partially releases the backup of the wiping member is provided.

36. ~~(Amended)~~ A printing screen cleaning device as claimed in claim 34, comprising: an elevation device ~~(522)~~ that pressurizes the backup member against the printing screen on the cleaning head or releases the pressurization; and a movement device ~~(524)~~ that makes the cleaning head advance under the printing screen from a standby position beside the printing screen and retreat from the screen and move under the printing screen.

37. ~~(Amended)~~ A printing screen cleaning device as claimed in [any one of] claims/ 34 [through 36], comprising: a supply section (541) that feeds and supplies the wiping member; and a winding section ~~(542)~~ that winds up the wiping member.

10031852-012402

38. (Amended) A printing screen cleaning device as claimed in
 [any one of] claims/ 34 [through 36], wherein the suction ports
 are arranged in an array in a direction inclined in the
 sliding direction.

5 39. (Amended) A wiping member backup member comprising: a
 backup surface ~~(506a)~~ for sliding a wiping member ~~(505)~~ on
 a printing screen ~~(504)~~ while backing up the wiping member;
 a suction region ~~(507)~~ provided in a direction roughly
 perpendicular to the sliding direction with a suction port
 10 ~~(508)~~ provided on the backup surface; and a groove ~~(509)~~
 extended parallel to the suction region.

40. (Amended) A printing screen cleaning method for cleaning a
 printing screen by sliding a wiping member ~~(505)~~ on a lower
 surface of the printing screen ~~(504)~~ for supplying a
 15 printing paste ~~(503)~~ onto a circuit-forming body ~~(502)~~
 through a printing paste supply section ~~(501)~~ of a
 specified pattern with the wiping member ~~(505)~~ backed up by
 a backup member ~~(506)~~ so as to wipe the printing paste
 stuck to the lower surface and sucking the paste via the
 20 wiping member through suction ports ~~(508)~~ provided through
 the backup member, whereby the printing paste that is stuck
 to the lower surface of the printing screen or staying in
 the printing paste supply section is stuck by suction to a
 wiping member side and kept by the wiping member,

25 the cleaning being performed by continuously

10031852 042402

sucking by the suction ports arranged side by side in a sliding direction.

41. ~~(Amended)~~ A printing screen cleaning device for supplying a printing paste ~~(503)~~ onto a circuit-forming body ~~(502)~~ through a printing paste supply section ~~(501)~~ of a specified pattern, comprising:

a cleaning head ~~(521)~~ that sucks the paste via a wiping member ~~(505)~~ while sliding the wiping member on a lower surface of a printing screen ~~(504)~~ with the wiping member backed up by a backup member ~~(506)~~ through a suction port ~~(508)~~ provided on a backup surface ~~(506a)~~ for performing the backup, wherein

a plurality of suction ports are arranged side by side in a sliding direction on the backup surface, and suction is continuously performed by the plurality of suction ports.

42. ~~(Amended)~~ A printing screen cleaning device as claimed in claim 41, wherein the plurality of suction ports are provided in a suction region ~~(507)~~ extended in a direction roughly perpendicular to the sliding direction on the backup surface of the backup member, arranged parallel to the suction region and have suction areas reduced stepwise.

43. ~~(Amended)~~ A printing screen cleaning device as claimed in claim 41 or 42, wherein the plurality of suction ports are arranged in proximity to each other.

44. (Amended) A printing screen cleaning device as claimed in claim 41 [or 42], wherein the plurality of suction ports are provided laterally symmetrically in the sliding direction.

45. (Amended) A printing screen cleaning device as claimed in claim 41 [or 42], comprising: an elevation device ~~(522)~~ that pressurizes the backup member against the printing screen on the cleaning head or releases the pressurization; and a movement device ~~(524)~~ that makes the cleaning head advance under the printing screen from a standby position beside the printing screen and retreat from the screen and move under the printing screen.

46. (Amended) A printing screen cleaning device as claimed in claim 41 [or 42], comprising: a supply section ~~(541)~~ that feeds and supplies the wiping member; and a winding section ~~(542)~~ that winds up the wiping member.

47. (Amended) A printing screen cleaning device as claimed in claim 41 [or 42], wherein the suction ports are arranged in an array in a direction inclined in the sliding direction.

48. (Amended) A wiping member backup member comprising: a backup surface ~~(506a)~~ for sliding a wiping member ~~(505)~~ on a printing screen ~~(504)~~ while backing up the wiping member; and a suction region ~~(507)~~ provided in a direction roughly perpendicular to the sliding direction with a suction port ~~(508)~~ provided on the backup surface, the suction port being comprised of a plurality of suction ports, which are

10031855 012402

arranged parallel to the suction region and side by side in the sliding direction.

10031052.012402